Measurement of Combustion Response to Transverse Modes at High Pressure

Completed Technology Project (2011 - 2015)

Project Introduction

The coupling between acoustics and unstable combustion has been a prime concern and unsolved problem over the entire modern history of chemical propulsion. These instabilities are extremely complicated due to the myriad potential coupling mechanisms and multiple length and time scales of the combustor and combustion processes. With frequencies greater than 1000 Hz, high-frequency combustion instabilities can impact combustor performance and lead to catastrophic failure due to overheating. Experimental work at Purdue is part of a larger effort to integrate experimentation, high order models, and engineering level models to better predict combustion instability and to better serve future engine design and performance. An absolutely unique experiment is being used to provide a representative unstable flowfield to which the response of propellant combustion can be measured. Imaging processing techniques are used to identify combusting structures in injector flowfields and their response to pressure and velocity instabilities. Combustion light intensity as measured by a filtered high speed camera is used as an indicator of local unsteady heat release. Combining heat release and high frequency pressure measurements, the damping and driving effects of an injector shall be identified based on Rayleighís criterion of instability. These data are compared to high fidelity computer models to distill combustion response functions that can be used in engineering-level models. When fully developed this diagnostic method could be deployed on operational rocket engines to actively control against unstable behavior or implemented on research combustors for more standardized, complete experimental results.

Anticipated Benefits

When fully developed this diagnostic method could be deployed on operational rocket engines to actively control against unstable behavior or implemented on research combustors for more standardized, complete experimental results.

Project Image Measurement of Combustion Response to Transverse Modes at High Pressure

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

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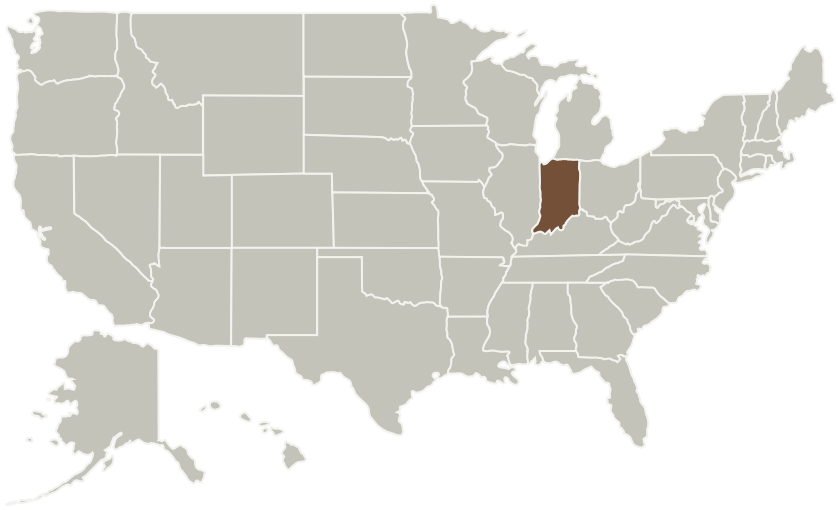
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Purdue University-Main Campus	Supporting Organization	Academia	West Lafayette, Indiana

Primary U.S. Work Locations
Indiana

Project Management

Program Director:
Claudia M Meyer

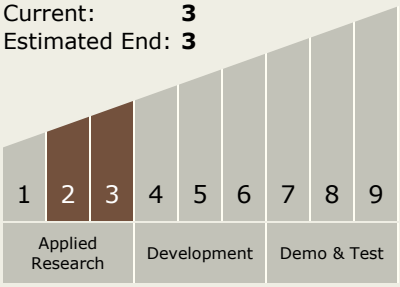
Program Manager:
Hung D Nguyen

Principal Investigator:
William R Anderson

Co-Investigator:
Matthew K Wierman

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.3 Aero Propulsion
    - TX01.3.4 Pressure Gain Combustion

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Images

4229-1363192114653.jpg
Project Image Measurement of Combustion Response to Transverse Modes at High Pressure
(https://techport.nasa.gov/image/1791)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html